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ABSTRACT

This study involved a direct comparison of existing instrument techniques to determine how each technique adds to a total reading program. Also studied was the order in which various techniques are best used in a program. The subjects were 60 students who were enrolled in a two-year academic center preparing students for employment in both agriculture and business-related fields. Experimental groups were formed utilizing the following combinations: (1) Skimmer and Novel; (2) Tach-X and Novel; (3) Controlled Reader and Novel; (4) Controlled Reader and Tach-X; (5) Controlled Reader , Novel, and Tach-X; and (6) Controlled Reader, Skimmer, and Novel. After the subjects had been assigned to groups and times had been scheduled, subjects were instructed in the technique to be used in their group. The groups met four times a week for 55-minute sessions for a period of ten weeks in individual reading rooms prepared for their program. The same teacher and reading aide supervised all phases of the program. The major results indicated: (1) the increase in reading rates over time was significant; (2) the learning combination showing greatest learning progress was the Controlled Reader, Skimmer, and Novel combination; and (3) the increase in reading over time was least significant when the Skimmer or Tach-X was the only instrument used during the first six weeks of instruction. (WR)

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Quantification of Contributions Made By Various Reading Instrument Combinations to the Reading Process

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INTRODUCTION

In recent years the educational market has been flooded with many innovations in instrumentation to provide improved reading performance. Data collected from studies of programs using instruments seem to have clarified, or at least identified, many existing problems in determining how individuals develop in the reading process. A problem emerges as to quantification of the actual contribution made by various reading instruments to the reading act. Overall, studies of reading instrument use show that instruments do contribute measurably to the various skills employed within a comprehensive reading program. However, little research has been conducted to date to show what part each instrument technique plays in the total reading gain of students. In this study, an attempt will be made to provide some information on the degree to which various reading instruments contribute to the gain in major aspects of the reading process.

A Review of Reading Instrument Research

It would seem appropriate to examine pertinent literature relevant to instrument usage and in particular to methodology employed in various populations and age groups. An effort was made to provide at least one example of instrument usage at different age levels.

Controlled Reader

Beckley (1) investigated the effectiveness of the EDL Controlled Reader in an elementary school program. The purpose of the study was to determine whether the reading program could be accelerated and to determine the amount of increase in reading speed, vocabulary, and comprehension which would result from the accelerated reading program using the Controlled Reader. The subjects were 137 children. The experimental group consisted of 41 second-grade students who were followed through their second- and third-year reading program. The control group included 96 students who had completed grades two and three in the school in previous years. Students in both experimental and control groups used the regular basal reading program but only the experimental group had supplementary instruction with the Controlled Reader. For this group the Controlled Reader

was used once a week for thirty minutes throughout the duration of the study. Initially the Controlled Reader training was given on a total class basis. By the end of the third month of the two year experiment, differences in reading rates indicated that the students should be grouped for Controlled Reading training and, accordingly, three reading groups were established. Achievement pretests and posttests were utilized to determine progress. Results indicate that over the two-year period, the mean reading achievement scores of the group using the Controlled Reader exceeded that of the control group by 1.1 grade equivalent units. Also, eye movement photography graphs revealed that the Controlled Reader helped reduce the number of fixations and regressive eye movements. The investigator inferred from these data that the Controlled Reader can be a valuable tool in increasing the reading rate and efficiency of primary children and that the instrument helped to correct poor reading habits by helping students develop proper left to right eye movements.

Blackwell (3) conducted a similar study with the Controlled Reader. The purpose of this study was to determine whether the Controlled Reader can effect significant growth in reading rate and comprehension for children in special reading classes. The study involved 28 boys and 13 girls from the fourth, fifth, and sixth grades. These students were classified as being from the lower and middle socioeconomic levels. The subjects were selected for special reading classes by the principal and classroom teachers because of failure to read at grade level. Two fourth-grade classes, two fifth-grade classes, and two sixth-grade classes received Controlled Reader instruction of 35 minutes per day for a period of six weeks. Each child was allowed to progress at his own reading rate. The *Gates Reading Survey* was administered as a pretest and posttest, and was also administered as a follow-up test six weeks after termination of the experiment. The investigator's results suggested that fourth-grade pupils benefited significantly from Controlled Reader techniques as determined by criteria such as reading rate and comprehension test scores. Results for fifth- and sixth-grade level groups were inconclusive.

Bottomly (4) investigated the contribution of the Controlled Reader to determine if a special short-term reading program involving the Controlled Reader might be more effective in boosting reading speed and comprehension than the regular developmental reading program. The experiment involved 460 pupils from two elementary schools, one in an upper-middle socioeconomic neighborhood and the other in an upper-lower socioeconomic neighborhood. Experimental and control groups were from both fifth and eighth grades. The experiment lasted for a period of eight weeks. The daily program for both experimental groups was a forty-minute lesson which was conducted four times a week for the eighth grade and five times a week for the fifth grade, making a total of 32 sessions for grade eight and forty sessions for grade five. A reading achievement test was administered at the beginning of the experiment, immediately at its termination, and five months after the end of the experiment. The groups seemed to vary in progress depending upon socioeconomic level, with lower socioeconomic levels showing greatest improvement in reading performance. When a comparison was made between the tests given immediately upon termination of the experiment and the alternate form of the test given five months later, it was found with only one exception that the mean growth factors of the experimental group were greater than those of the control group and that the differences were significant. The investigators inferred that since the experiment showed a continuing benefit accruing to the students after the Controlled Reader program had terminated, this type of training should be considered as a natural element of the long-term developmental reading program.

A comparison of various reading instrument approaches, including the Controlled Reader, was conducted by Gelzer and Santore (7) and reported in 1968. The purpose of

this study was to compare a number of reading instruments and instrument techniques commonly used to increase rate and comprehension in secondary school reading programs. The techniques compared are the Controlled Reader, the Shadowscope accelerator, the Rateometer accelerator, and timed reading. One hundred and fifty-nine ninth-grade students who scored at the fiftieth percentile or higher on the *Iowa Silent Reading Tests* were selected to participate in this program. Each of five groups was given a different type of instruction: one used the EDL Controlled Reader with the left to right or guided slot; the second was trained with the Controlled Reader with open slot; the third used the Shadowscope, which employs a band of light that moves down the page; the fourth used the Rateometer, which moves a masking device down the page; and the fifth group, identified as the timed-reading group, worked against the clock.

For the six-week training period, students reported during their daily study hall period to a special room set aside for this experiment. The average time in class for each student was twenty minutes. Students read one selection during each session and then completed the accompanying comprehension questions. A pretest, a posttest, and a follow-up test were administered one year later. The tests used were *The Reading Eye Test Selections* (eye movement photography test) and the *Diagnostic Reading Tests.*

The investigators found on the various measures of reading performance for the five groups that the gains made by the group trained with the Controlled Reader, guided slot, were superior to those achieved through the use of other methods, if permanence of gain were a paramount consideration. When the *Diagnostic Reading Tests* scores were compared to determine the effect of the five techniques on reading rate, it was found that all techniques produce significant increases in rate scores at the end of the training period. However, 11 months later the Controlled Reader, guided slot, group showed the greatest retention of reading rate gain, significant at the .01 level. The Controlled Reader, guided slot, group was the only group that showed a reading rate increase following the end of the course. This study represents one attempt to investigate the actual gains provided by a reading instrument in an isolated situation.

Tachistoscope

Fox (5) postulated that a positive relationship existed between the ability to perceive tachistoscopically projected images and reading readiness test scores. This experiment involved students from five first-grade classes. Only 83 of the pupils still remained at the end of the second year of the study as compared with 127 who were present for the first year of the study. The students were from a small middle-socioeconomic community. Tachistoscopic training was given with the S.V.E. tri-purpose projector, equipped with a semi-automatic slide changer and Alphax shutter. The investigator inferred from the data that a positive relationship exists between reading readiness and the ability to perceive tachistoscopically projected images. Although his results seem to support his hypothesis, no indication was available to determine the degree to which the tachistoscopic training contributed to readiness as opposed to other factors. For example, there was no indication based on learning curve data to suggest what effects socioeconomic status, maturational level, or motivation have on visual functioning.

While many educators and manufacturers of reading equipment do not directly suggest that the tachistoscopic training produces significant effects upon reading rates, Renshaw (9)

sought to substantiate this effect with adults. The purpose of his study was to confirm the fact that tachistoscopic training with digits will produce significant increases in reading comprehension and an increase in rate of reading. The experiment involved two groups of adults, a total of 87 subjects. The subjects met for two training periods per week for 15 weeks. The training session was comprised of about 25 exposures each. Alternate forms of a standardized reading test for college students were given to both groups at the start, the middle, and the end of the thirty training sessions. Both groups evidenced gain in comprehension and reading rate scores. Although Renshaw felt that tachistoscopic training had some effect on reading comprehension and reading rate, these results are not adequately documented because there was no control group nor a reliable dependent variable that properly illustrated the progress. While Renshaw concluded that the tachistoscope was effective in increasing reading comprehension and rate with his groups, these observations could be regarded as particular to a highly unorthodox group (35 of the subjects had Ph.D.s) and an unusual learning situation.

Instrument Combinations

Warren (11) sought to answer the question, "What are the results of certain reading instrument procedures as a phase of a concentrated reading improvement program as revealed by standardized tests?" The study involved two groups of 25 students in two junior high schools. Students were selected on the basis of IQ scores and the *Iowa Silent Reading Tests* scores. The mean IQ of the control group was significantly higher than that of the experimental group. Despite differences in mean IQ, the two groups did not differ significantly on the initial testing with the *Iowa Silent Reading Tests.* The instructional schedule was set up for 21 sessions based on three class periods per week for seven weeks. Perceptual training consisted of a warm-up period of five to seven minutes using the Tach-X to project the digit and word selections. Also, junior high filmstrip selections were read on the Controlled Reader each class period. The control group used the same Controlled Reader selections as the experimental group except that the materials were not projected on the Controlled Reader. The perceptual training for the control group was accomplished by having the students use hand-held cardboard with window slits and other self-motivating techniques with selections identical to those of the experimental group except that they were in printed form.

On the *Iowa Silent Reading Tests* posttest, the analysis of variance computations indicated a significant difference existing between the two groups in favor of the experimental group in both rate of reading and total grade equivalent score. After training, comparisons of the experimental and control group results of the eye movement photography test posttest indicated that significant differences existed on all measures in favor of the experimental group. The investigator concluded that although both groups made gains, the experimental group exhibited significant mean score gains over the control group on the reading rate and total grade equivalent sections of the *Iowa Silent Reading Tests.* On the eye movement photography test, the experimental group indicated significant mean score differences in reduction of regressions and fixations and also a significant difference in mean score gains in reading rate with comprehension and in relative efficiency which was not matched by the control group.

Berger (2) was interested in determining the effectiveness of four methods of increasing reading rate, comprehension, and reading flexibility. The four methods used were the tachistoscope, the Controlled Reader, controlled pacing, and paperback scanning. His

results indicated that paperback scanning was a significantly superior method when compared with any of the other methods for improving reading rate and reading flexibility. None of the methods produced significant changes in comprehension. Berger was not able to determine the degree to which each method contributed to the total when used in combination with other techniques. Because he did not use eye movement photography in his evaluation, it was impossible to draw any conclusions pertaining to what criterion variables such as regressions and fixations were affected by particular parts of a comprehensive program.

An important criticism of all of the studies cited in this section, except possibly the Gelzer and Santore study, is that it is not possible to determine the effect of individual instruments from the total program. The data allows no determination to be made as to the effectiveness of the instruments alone or of any combination of instrument techniques. The present study did attempt to isolate reading rate as one measure which can provide some information on the degree to which various reading instruments contribute to the total gain in reading achievement. Instruments were used in various combinations so as to allow determination of any of the individual effects of a given instrument on reading rate.

THE PRESENT STUDY

As evidenced from the preceding review of literature, a research study which seems sorely needed involves a direct comparison of existing instrument techniques to determine how each technique adds to a total reading program. Also of interest is the question of the order in which various techniques are best used in a program. Perhaps certain instruments could be used more appropriately if educators had some evidence to indicate how much of a role each particular instrument played in improving the reading process.

The present design is intended to fill this void and provide insight with regard to several combinations of techniques and instruments included in EDL's Reading 300 Laboratory; namely, the Tach-X, Controlled Reader, Skimmer, and Novel (paperback books).

Using combinations of instruments and materials mentioned above, the following general hypotheses were examined:

(1) Programs involving the Controlled Reader facilitate significant changes in reading performance factors regardless of the particular treatment combination.

(2) Levels of comprehension will remain the same for any of the treatment combinations.

(3) The treatment combination utilizing the Controlled Reader, Tach-X, and Novel will make the greatest increase in reading rate.

Methodology

Subjects

The subjects of the experiment were sixty students who were enrolled during the spring quarter 1968 at the University of Minnesota Technical Institute, a two-year academic center preparing students for employment in both agriculture and business-related fields. While the students represented a broad sampling of a college student population, the majority of students came from a rural background. All beginning students were given information concerning their reading ability and encouraged to seek out means of improvement. A ten-week reading improvement course was arranged, giving course credit for one quarter. Registration was completely voluntary, although for this experiment the students selected were those who were within the normal range on the *American College Testing Program Exam-*

ination (ACT). The ACT provides a measure of general ability and is administered to college freshmen as a placement instrument in many universities. The sixty students were randomly assigned to one of six treatment groups (N for each group equals ten).

Reading rate pretest scores were evaluated by giving timed reading selections from Lyle Miller's *Maintaining Reading Efficiency* (8) and by eye movement photography using *The Reading Eye Test Selections*, published by Educational Developmental Laboratories. The students were homogeneous in initial reading level as indicated by the *Diagnostic Reading Tests* scores. An Analysis of Variance revealed no significant difference between the six experimental groups in *Diagnostic Reading Tests* scores and ACT scores.

All materials were taken from the Educational Developmental Laboratories' Reading 300 Program for secondary school and college populations. Instruments included the Controlled Reader (CR), Skimmer (SK), and Tach-X (TX). Materials utilized with the Tach-X included: *Advanced Accuracy Tach-X Set 40* (numbers, symbols, and letters), *Tach-X Vocabulary Sets* for grades ten through thirteen, and *Intermediate Supplementary Tach-X Set 31*. Controlled Reader materials included: Controlled Reader stories for reading levels 9-14 (sets IJ, JI, LK, and MN). The *Skimming and Scanning* text and workbooks were used on the Skimmer. In addition to these materials, reading levels 9-14 (sets IJ, KL, and MN) of EDL's *Reading 300 Library B* of paperback novels were utilized.

The Reading Eye I instrument was utilized to provide objective indications of changes in four components of reading performance: Average duration of fixation, number of fixations per 100 words, number of regressions per 100 words, and reading rate (wpm) with comprehension.

Procedure

Experimental groups were formed utilizing the following combinations: Group 1 (Skimmer and Novel); Group 2 (Tach-X and Novel); Group 3 (Controlled Reader and Novel); Group 4 (Controlled Reader and Tach-X); Group 5 (Controlled Reader, Novel, and Tach-X); and Group 6 (Controlled Reader, Skimmer, and Novel). Both Groups 1 and 2 utilized the Controlled Reader starting in the seventh week of the ten-week course. This was indicated by a plus sign; i.e., Group 1 (Skimmer and Novel + Controlled Reader). After students were assigned to groups and times had been scheduled, the subjects were instructed in the technique to be used in their group. Groups met four times per week for 55-minute sessions for a period of ten weeks in individual reading rooms prepared for their program. The same teacher and reading aide supervised all phases of the program.

Charts of students' biweekly reading rate test scores were obtained by gathering reading rate scores for selections in *Maintaining Reading Efficiency* (Miller) and administering comprehension checks for each selection. Two weekly indications were gathered, mainly to provide a more stable and reliable indication of progress than a single indicator would and also to give immediate feedback to provide subjects with evidence of their progress. These biweekly test scores were averaged and a single score was obtained to represent the weekly reading rate. Comprehension checks consisted of multiple choice items, completion, and true-false items. Eye movement photographs, taken with the Reading Eye I instrument, were used every two weeks during the ten-week course.

The daily instructional session was varied for each group depending upon combination of instruments and materials. Group 1 alternated use of the Skimmer and Novel several

times throughout each session. Group 5 used the Controlled Reader, Novel, and Tach-X during each period. Tach-X training ranged from 8 to 14 minutes, Controlled Reader training was one or two stories, and the remaining time was spent on Novel reading. The operator presented the instruments and materials in essentially the same manner. In all groups the same instruments and materials were used by the student during every session. Reading speeds on the Controlled Reader were controlled by the student, although initially he was encouraged to begin at a comfortable rate as indicated by the Reading Eye I pretest (approximately 200 wpm). Tach-X training began at the slower speeds in the initial sessions; a 1/100-second presentation rate was used for the remaining sessions.

The major statistical design was Analysis of Variance with a special case for repeated measures over individuals to increase precision and control for random error.

Findings

General Results

Each of the six experimental treatment conditions is represented by a learning curve extending over a ten-week period, as shown in Figure 1. Particular note should be made of Groups 1 and 2. In Group 1 the Skimmer and Novel were the only two components to the reading program. However, during the seventh week, an additional component, the Controlled Reader, was added in an attempt to increase the performance level. The addition of the Controlled Reader to the group was denoted by "+CR" in the legend of the figure. The same reasoning applied to Group 2, where the original components included the Tach-X and Novel.

General results of the treatment techniques can be seen in the analysis of variance figures in Table 1. This table represents a 6 X 10 Treatment by Weeks factorial design with repeated measures on the "Weeks" factor. There were ten subjects per cell for a total of 60 subjects. The dependent variable was the weekly reading rate expressed in words per minute.

TABLE I

ANALYSIS OF VARIANCE FOR ALL TREATMENTS OVER LEVELS
N = 60

Source of Variation	Sum of Squares	d.f.	Mean Squares	F
Between Subjects	**2,858,297.125**	**59**		
Treatment Groups	2,852,270.875	5	570,454.18	5111.6**
Subjects within Groups	6,026.250	54	111.6	
Within Subjects	**3,468,469.500**	**540**		
Weeks	2,206,971.705	9	245,219.08	2283.93**
Treatments X Weeks	1,220,174.545	45	27,114.98	318.78**
Weeks X Subjects within Groups	41,323.250	486	85.03	

**$P < .01$, the 99 percent level of confidence.

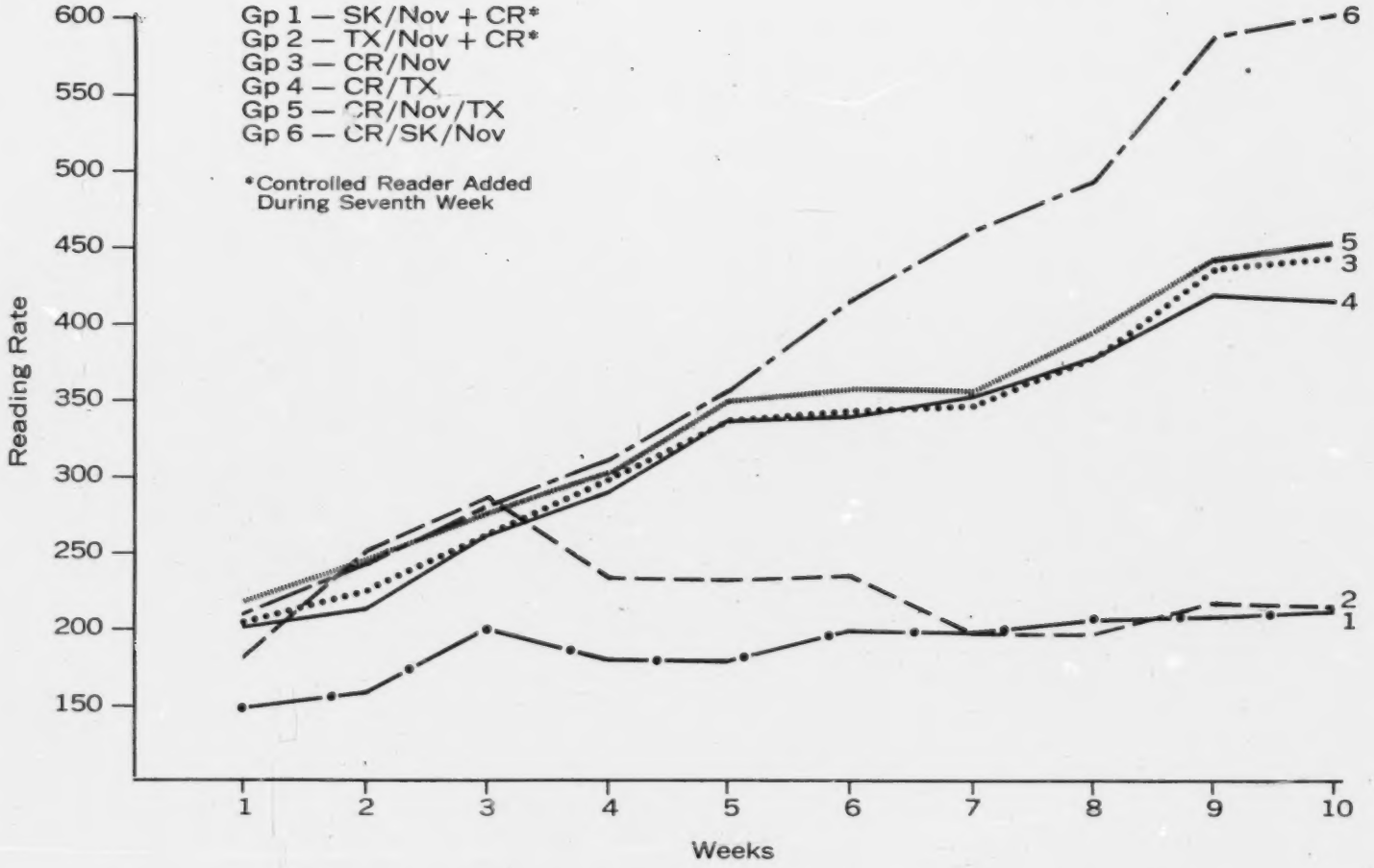

FIG. 1. COMPARISONS OF READING RATES USING VARIOUS INSTRUMENT COMBINATIONS

Examination of Table 1 shows the main effects of treatments and blocks of trials which were significant. There was a significant interaction between treatments and weeks.

The Newman-Keuls test of significance was used to test the significance of differences between important pairs of treatment groups at various stages during the ten-week course. In the third block of trials, or the third week of the course, there were no significant differences among Groups 2, 5, and 6, nor between Groups 3 and 4. A significant difference was observed between Group 1 and all other groups. Significant differences were also noted between Groups 2, 5, and 6 and Groups 3 and 4.

At the end of the tenth week learning curves appeared much more separated, as can be seen in Figure 1. The reading rate of Group 6, Controlled Reader/Tach-X/ Novel, was significantly higher when compared to other groups. There was no significant difference in the reading rates of Groups 3 and 5, nor between Groups 1 and 2. Significant differences were obtained for all other pair-wise comparisons of treatment groups.

A brief summary of major results:

(1) The increase in reading rates over time was significant.

(2) The effects of treatments over time were significant with treatments utilizing the Controlled Reader (Groups 3, 4, 5, and 6) showing a more rapid learning curve. The learning combination showing greatest learning progress was the Controlled Reader/ Skimmer/Novel combination (Group 6).

(3) The increase in reading rates over time was most significant for treatments utilizing the Controlled Reader, and least significant when the Skimmer or Tach-X was the only instrument used during the first six weeks of instruction.

Specific results and suggested uses are discussed under the instrument subheadings in the following sections.

Controlled Reader

Figure 2 compares all groups that utilized the Controlled Reader as a major instructional device. As already noted, all groups using the Controlled Reader did significantly better than groups who did not utilize the instrument. Groups 3, 4, and 5 are relatively similar with regard to overall learning progress. A comparison of the learning rates of these groups seems to indicate that the addition of either the Tach-X or the Novel to the Controlled Reader contributes about the same amount of gain and thus allows for an alternate form of added training. As one examines Group 5, which adds both the Tach-X and Novel to the Controlled Reader, one finds a noticeable increase in reading rate over the Controlled Reader/Tach-X or Controlled Reader/Novel combination used separately.

While Group 6 shows greater reading progress than either Group 3 or Group 4 during the first four weeks, this reading difference is especially accentuated after the fourth week. In fact, when Group 6 was compared to Group 5, there was no perceivable difference until around the fourth and fifth weeks. At a reading rate of approximate' 350 wpm a rather curious effect occurred, causing reading rate to shoot up greatly. It seems possible that the effect of the Skimmer was not significant until such time when each

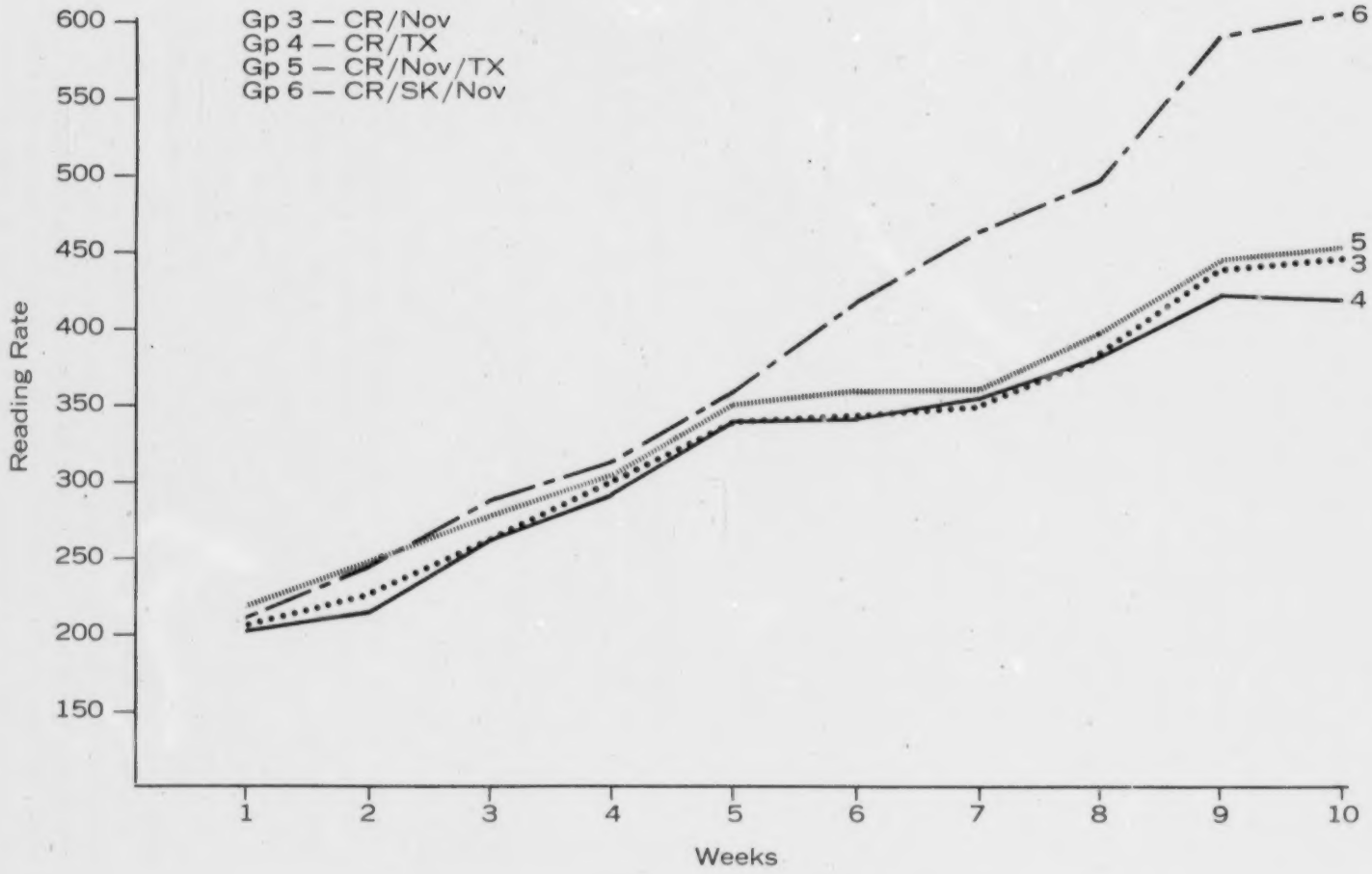

FIG. 2. CONTROLLED READER COMPARISONS

individual acquired a certain basic rate; in this case, that rate is suggested to be 350 wpm. At the point in time where each student becomes fairly confident and has progressed in reading rate, the Skimmer seems to make a major contribution.* This would have important ramifications for programming and use of the Skimmer.

Tach-X

The learning curves of the three groups that utilized the Tach-X are shown in Figure 3. The most striking effect seems to revolve around the unusual learning curve charted by Group 2. During the initial learning sequence, the rate of learning in Group 2 is equal to, and in some cases greater than, any other Tach-X group. But after the third week, there is a noticeable decline that continues throughout the entire sequence. Even when the Controlled Reader is added during the seventh week, there is no meaningful increase in reading rate. This suggests that after initially good progress and high motivation had been established, there was little in this combination of instruments that contributed to an increase in reading rate after the 280 wpm level was reached. In fact, the lack of additional stimulation at this time actually had a depressing effect on rate of learning as evidenced by decline in the learning curve, shown in Figure 3. Interestingly, addition of the Controlled Reader during the seventh week did not spur the interest or boost the learning rate of subjects deprived of additional stimulation between the third and seventh weeks. Even though this group read the paperback novel, little gain was evidenced by the end of the course. This again, is contrary to the belief that any combination will produce results (Berger) (2). In the opinion of the investigators, one way to restore high motivation to Group 2 would be to stop altogether and begin a new program at a later date when the teacher can insure success experiences for the subjects throughout the entire learning sequence by carefully selecting appropriate techniques indicated as effective in this study.

Interesting results are found when comparing Group 4 and Group 5. Group 4 and Group 5 both used the Controlled Reader/Tach-X combination, and Group 5 used the Novel in addition. As might be expected, the Novel seemed to contribute a small, but important, effect on rate of learning. While Group 5 maintained a slightly greater rate of increase, the difference was not great enough to be statistically significant.

Figure 4 presents a comparison of reading rates for the top three students and lowest three students in all three groups using the Tach-X as a component to the program. It can be seen from the figures that contrary to expectations, the "low" group shows initially greater reading rate than the "high" group. Only Group 2 shows this initial increase at a significant level, but the other two groups all tend to approach the same trend. This trend may support the notion that with slower learners initial use of the Tach-X can make a significant contribution, whereas with more gifted readers the Tach-X may have a lesser impact. The Tach-X seemed to provide motivation for the slower reader, probably because it offered immediate feedback and learner success, and was responsive to the subjects' greater need for perceptual accuracy.

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*The publisher recommends that the Skimmer be used with "students who are capable and efficient readers, but also need instructions in selective reading." Quote taken from *Skimming and Scanning*, Teacher's Guide, EDL, 1968.

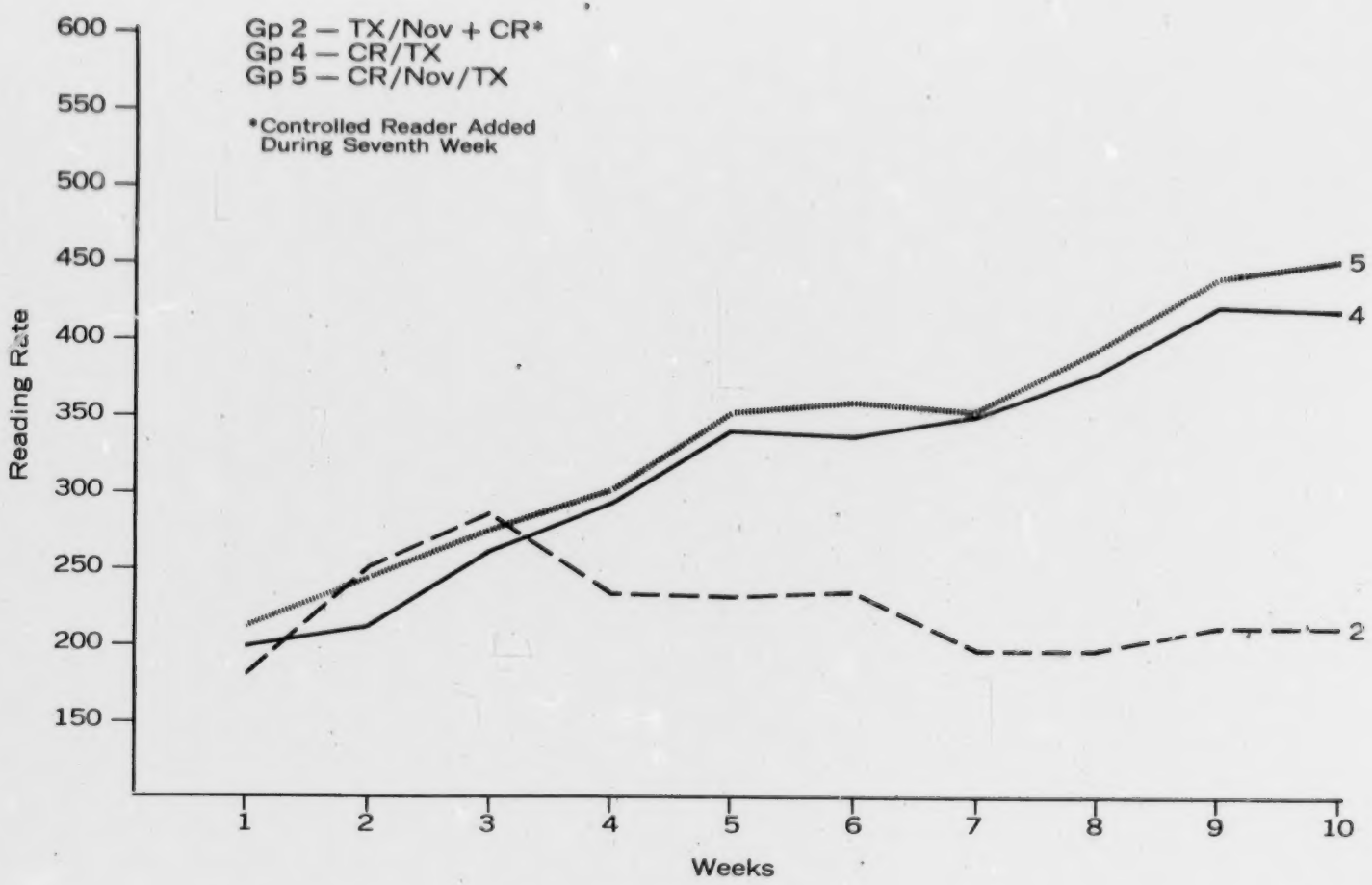

FIG. 3. TACH-X COMPARISONS

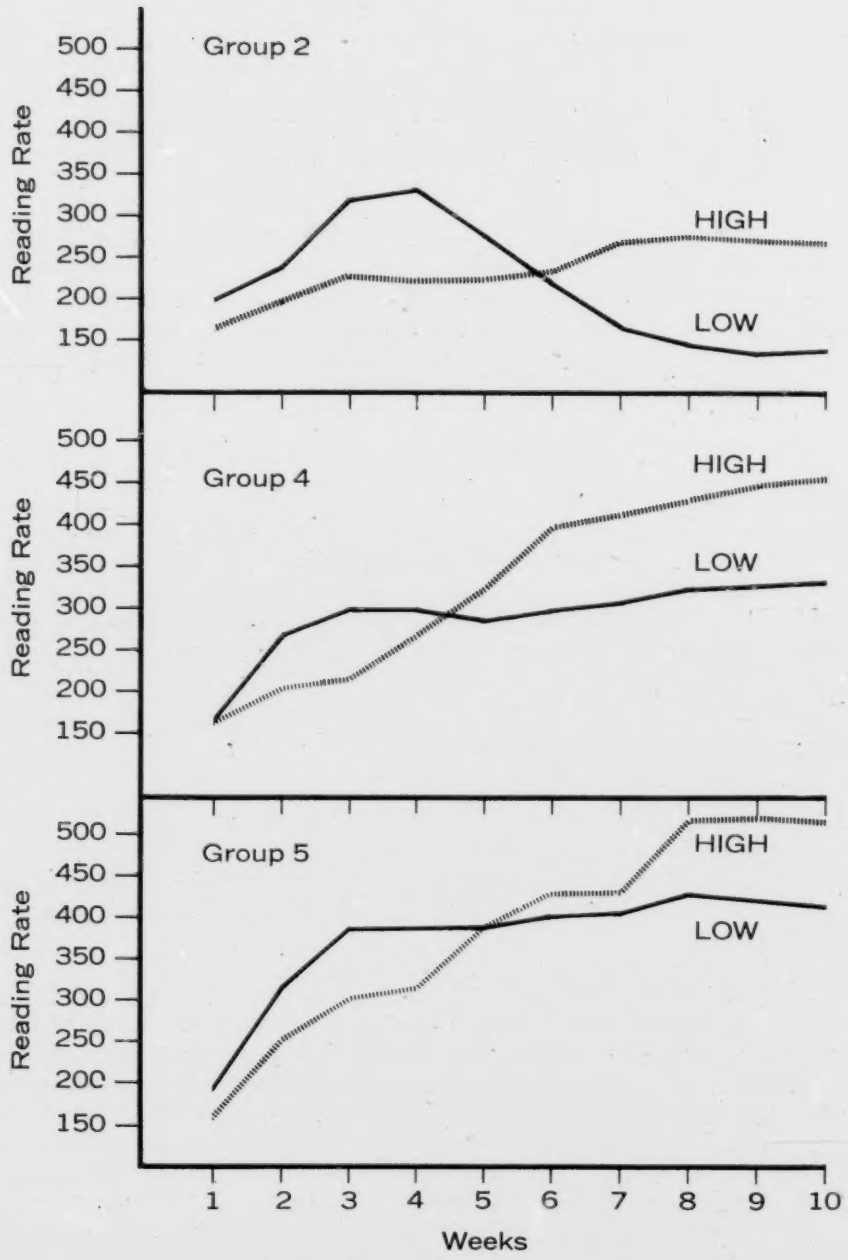

FIG. 4. COMPARISONS OF GROUPS USING THE TACH – X, COMPARING 3 HIGHEST & 3 LOWEST STUDENTS IN EACH GROUP.

Skimmer

In light of previous interpretations within the experiment, it remains a relatively easy task to examine the effect of the Skimmer as shown in Figure 5. Obviously, the greater rates of increase, when compared to other instrument combinations, began in the fourth week for Group 6. At approximately the 300 wpm level it seems that the Skimmer-type activity of selective reading contributes a great deal. This is in line with the recommendations of the EDL Teacher's Guide for the Skimmer.

However, as one examines the Skimmer-type activity when students are reading below 200 wpm, Group 1 illustrates the impending disaster. In this learning situation, even the addition of the Controlled Reader in the last three weeks seemed to have little influence. This suggests the possible retarding effect of the Skimmer at the low level of reading ability. This finding is supported by research by Gallegos (6) who suggests that fast pacing without perceptual and directional control is a poor technique for slow learners.

A comparison of the learning curves for Groups 3 and 6 (Figure 1) illustrates the specific advantage of using the Skimmer during the later stages of instruction. The two groups differ in that Group 3 used the Controlled Reader and Novel, whereas Group 6 used the Controlled Reader, Novel, and Skimmer. The learning curves of the two groups are approximately similar until the fifth week of instruction. Beyond this point, the effect of the Skimmer seems to show up in a greater acceleration in the growth of the learning curve for Group 6 as compared to that of Group 3. This seems to emphasize our earlier contention that the Skimmer can be optimally used after the student has established a basic rate of at least 350 wpm.

Eye Movement Photography Results

Reading performance refers to gains made by students in basic, measurable criterion variables such as fixations, regressions, and rate of reading with comprehension. Table 2 presents the pretest and posttest results of reading performance as measured by the Reading Eye I camera. An attempt will be made to compare students' change in this study to normative data provided by Taylor (10).

Examining the first rows in Table 2, it is evident that Groups 2, 4, and 5 changed most in reducing the average duration of fixations. These three groups are the only groups that utilized the Tach-X. While the Controlled Reader was used for the entire ten weeks in two of these groups (4 and 5), it is not considered the major influence in reducing the average duration of fixations because in Group 2 the Tach-X was used for ten weeks whereas the Controlled Reader was used for only the last three weeks. Taylor suggests that if a program in reading improvement were to be successful, then the subject's durations should show a definite change to shorter durations toward the range of .22 – .25 seconds.

As the number of fixations per 100 words are examined in the second row of Table 2, it can be observed that Groups 3, 4, 5, and 6 made greater changes in number of fixations compared to Groups 1 and 2. The Group 2 change seemed quite insignificant in light of other changes. Looking at the learning curve for Group 2, it becomes evident that something happened to the performance level after the third week. In all measurements of reading performance except duration of fixations, the effects of the treatment condition in Group 2 were consistently reflective of poor progress.

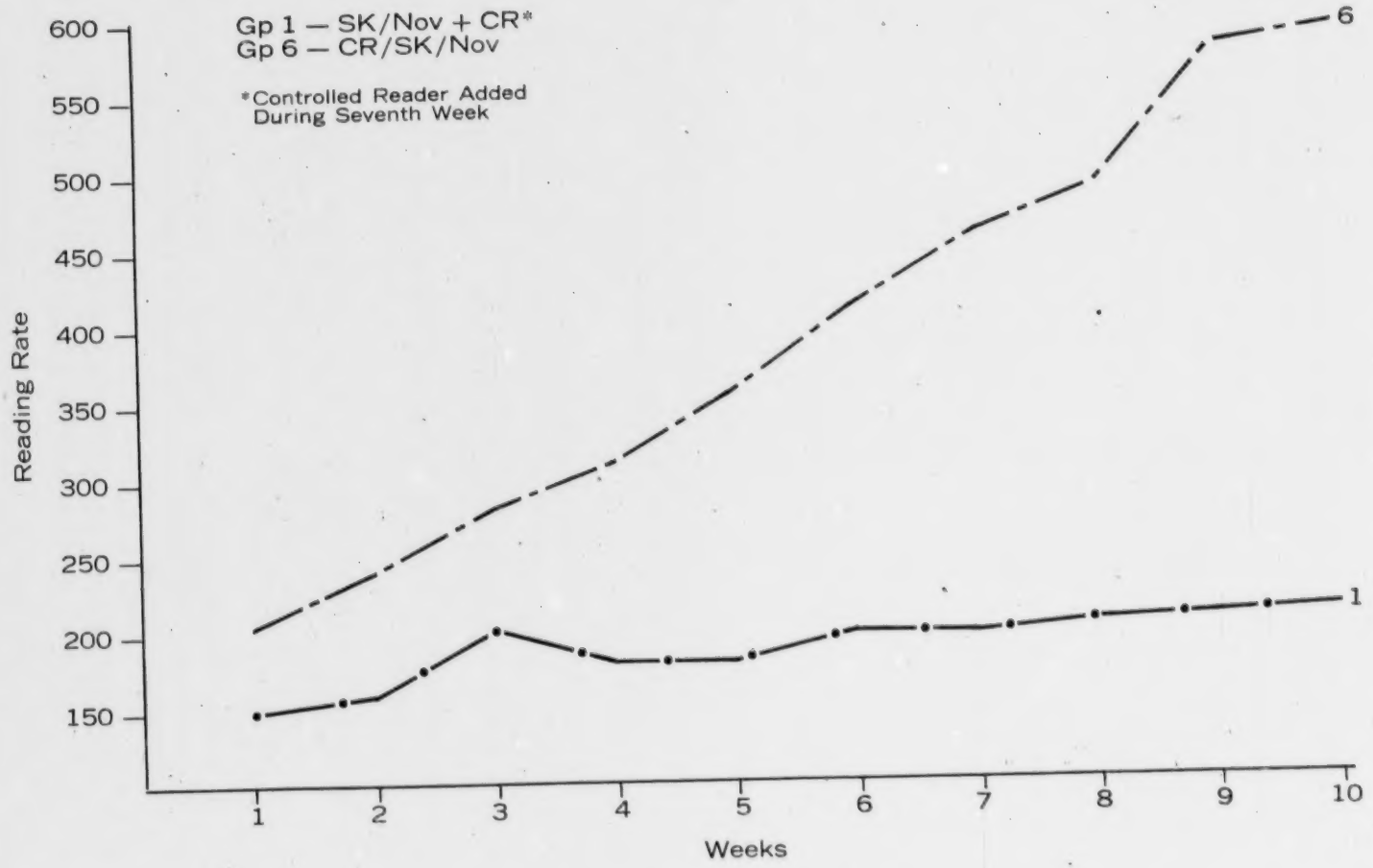

FIG. 5. SKIMMER COMPARISONS

TABLE II

READING PERFORMANCE PROGRESS DURING A TEN-WEEK PERIOD AS MEASURED BY EYE MOVEMENT PHOTOGRAPHY*

		SK NOV +CR 1	TX NOV +CR 2	CR NOV 3	CR TX 4	CR NOV TX 5	CR SK NOV 6
Avg. Duration of Fixation (in seconds)	Pre	.27	.27	.27	.27	.27	.27
	Post	.26	.23	.25	.23	.24	.25
No. of Fixations per 100 Words	Pre	143	139	143	143	139	143
	Post	115	130	80	84	76	66
No. of Regressions per 100 Words	Pre	23	23	22	23	22	22
	Post	21	22	19	15	16	15
Rate with Comprehension (words per minute)	Pre	155	160	155	155	160	155
	Post	200	200	300	310	330	365

*Reading Eye I distributed by Educational Developmental Laboratories was used to collect this pretest and posttest data.

The greatest reduction in number of regressions per 100 words appears within Groups 3, 4, 5, and 6. The Controlled Reader was used for ten weeks in all of these groups and seems to be a major influencing factor in reducing regressions. Comparing posttest scores with Taylor's norms for the number of regressions per 100 words suggests that Groups 4, 5, and 6 were functioning at college level.

A fourth major component of the reading progress measured was rate with comprehension. All groups improved, but only Groups 3, 4, 5, and 6 made impressive gains when compared with Taylor's normative data. While college students in Taylor's norming sample had an average reading rate of 280 words per minute, Groups 4, 5, and 6 raised their reading rate beyond this level.

Essentially, general results provided by the Reading Eye I camera suggest several rather important considerations:

(1) Eye movement photography, when used as an evaluation technique, provides reliable and relevant data for reading research studies. It provides a reasonable way to collect progress data over time and allows feedback to both researcher and student in a manner that has great face validity.

(2) Eye movement photography results were generally consistent with the findings concerning the degree of progress found in the reading rate criteria using the Miller *Maintaining Reading Efficiency* selections.

(3) Regressions were significantly decreased in Groups 4, 5, and 6 and appreciably reduced in Group 3. All of these groups used the Controlled Reader for ten weeks.

(4) From the above results on reduction of regressions, it might be predicted that a reduction of fixations would be greatest for combinations using the Controlled

Reader. Results indicate that expectations were confirmed. The groups using the Controlled Reader for the full ten weeks showed greatest decrease in numbers of fixations.

(5) All the groups (Groups 2, 4, and 5) that used the Tach-X showed the greatest decrease in duration of fixation.

(6) Two of these groups (Groups 4 and 5) that used the Tach-X for the ten weeks showed a large decrease in number of fixations. However, when the Tach-X is not used in combination with the Controlled Reader, such as in Group 2, then there is only a small decrease in number of fixations.

(7) The group that used the Skimmer in combination with the Controlled Reader (Group 6) made the greatest increase in rate of reading (wpm) with comprehension as compared to the groups that used the Controlled Reader without the Skimmer.

Conclusions

It may be concluded from the results of this study that each of the instruments, the Controlled Reader, Tach-X, and Skimmer, primarily affect specific components of the reading process, and that they have differential value at different stages of reading instruction.

Further, the trend analysis research design used in the study can be used as a model to assess effectiveness of components of other programs.

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